Fig. 1

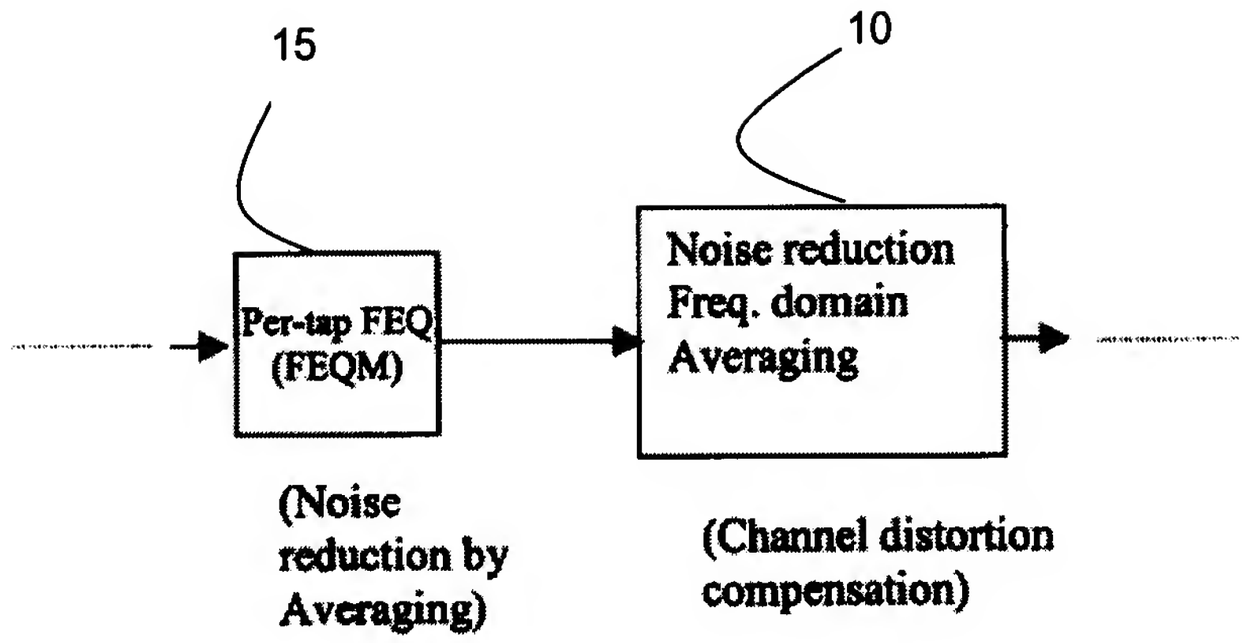
15
10
Per-tap FEQ
(FEQM)
(Noise
reduction by
Averaging)
Noise reduction
Freq. domain
Averaging
(Channel distortion
compensation)

Fig. 2

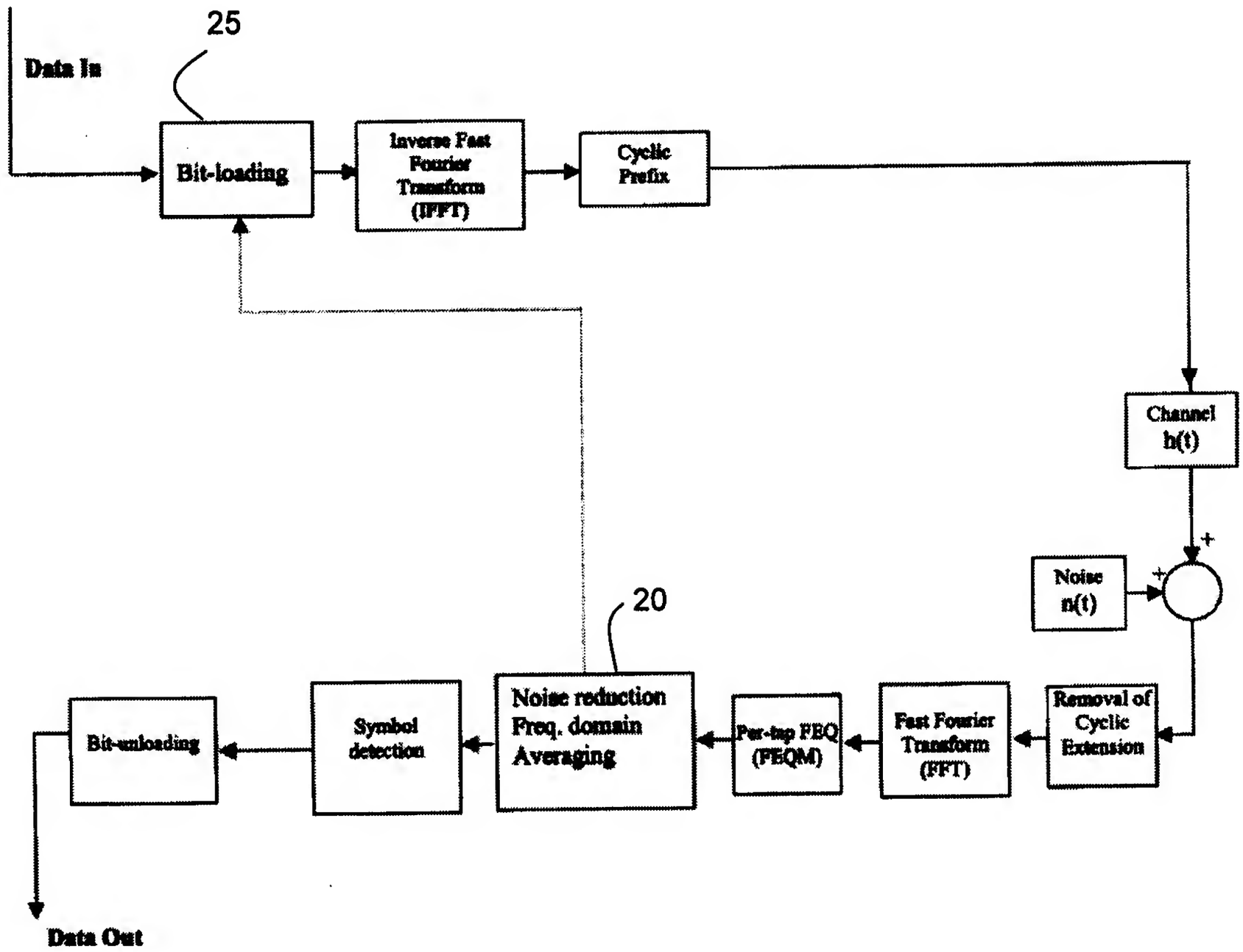
25
Data In
Bit-loading
Inverse Fast Fourier Transform (IFFT)
Cyclic Prefix
Channel h(t)
Noise n(t)
+
+
Removal of Cyclic Extension
Fast Fourier Transform (FFT)
Per-tap FEQ (FEQM)
20
Noise reduction Freq. domain Averaging
Symbol detection
Bit-unloading
Data Out

Fig. 3

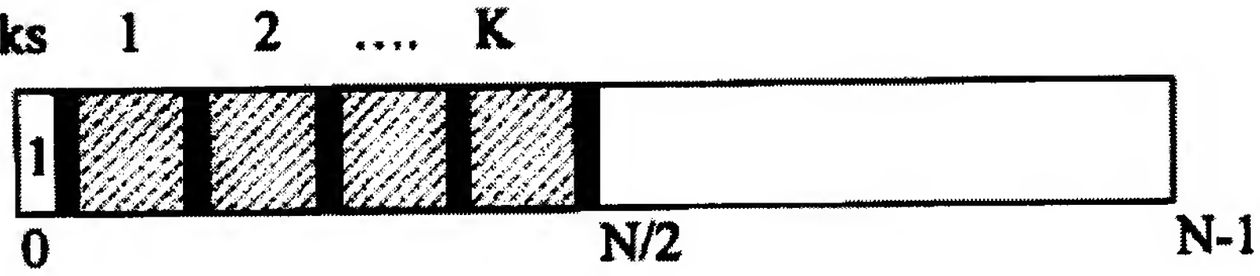

Fig. 4

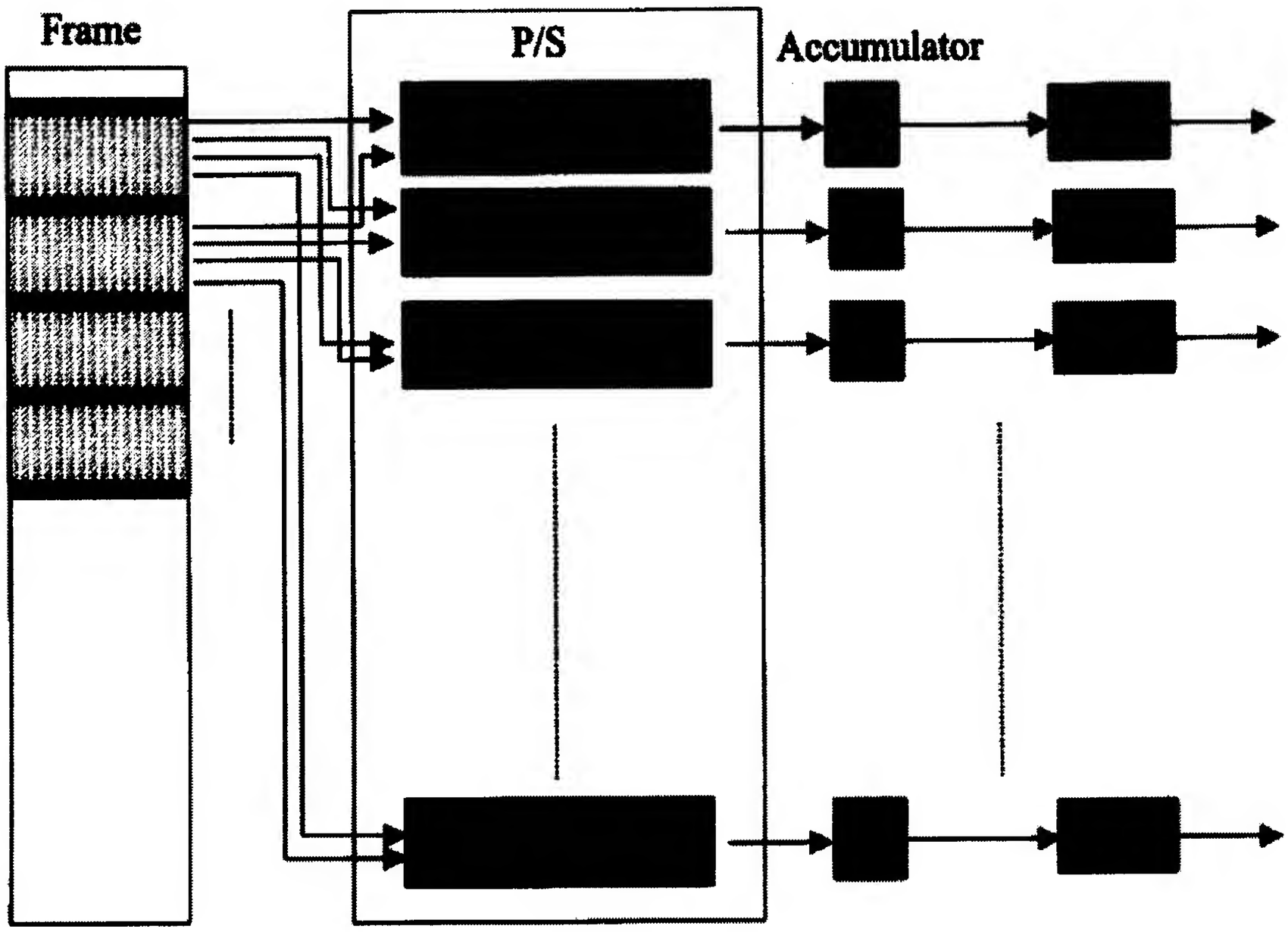

Fig. 5

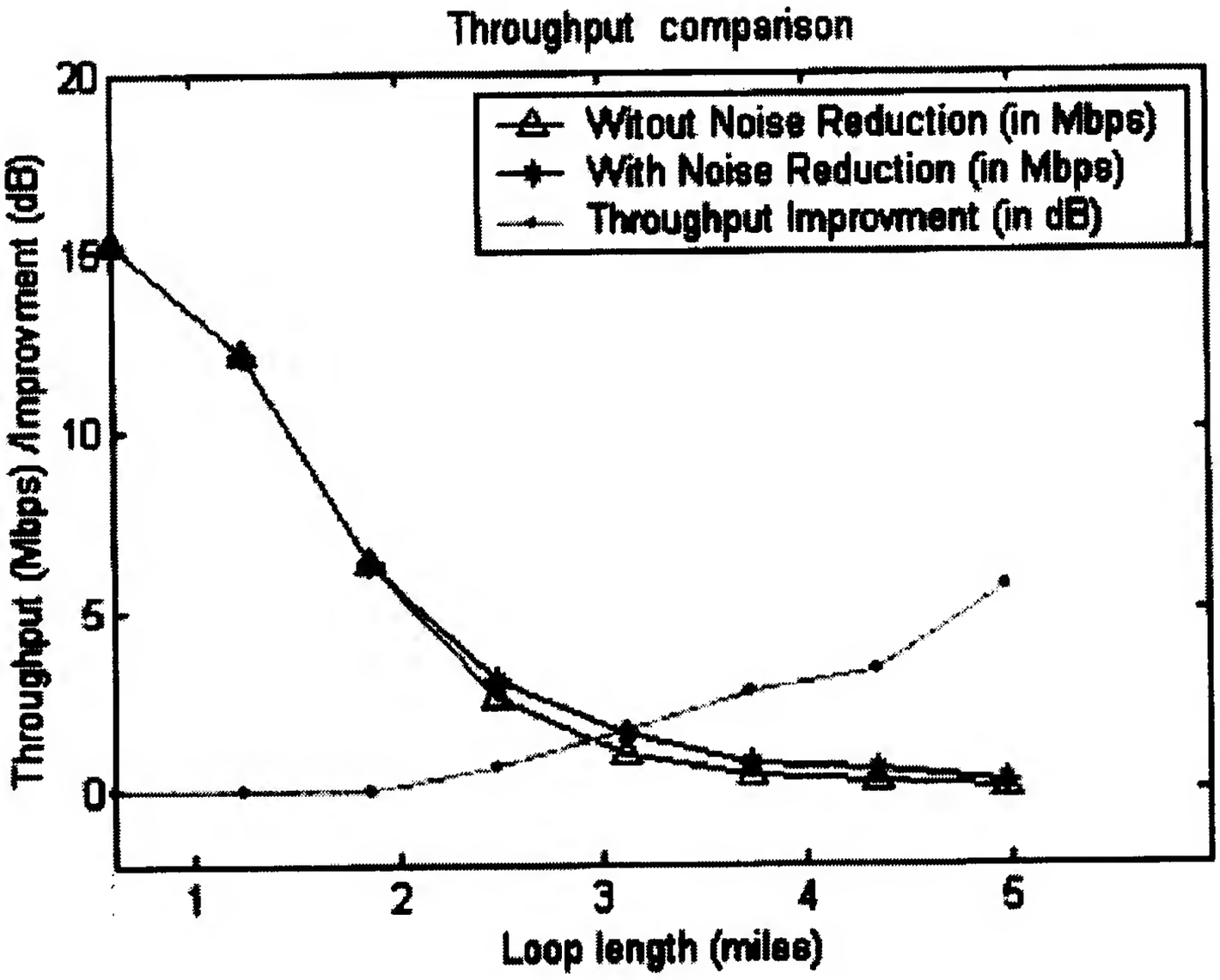
Throughput comparison
Witout Noise Reduction (in Mbps)
With Noise Reduction (in Mbps)
Throughput Improvment (in dB)
Throughput (Mbps) /Improvment (dB)
20
15
10
5
0
1
2
3
4
5
Loop length (miles)

Fig. 6

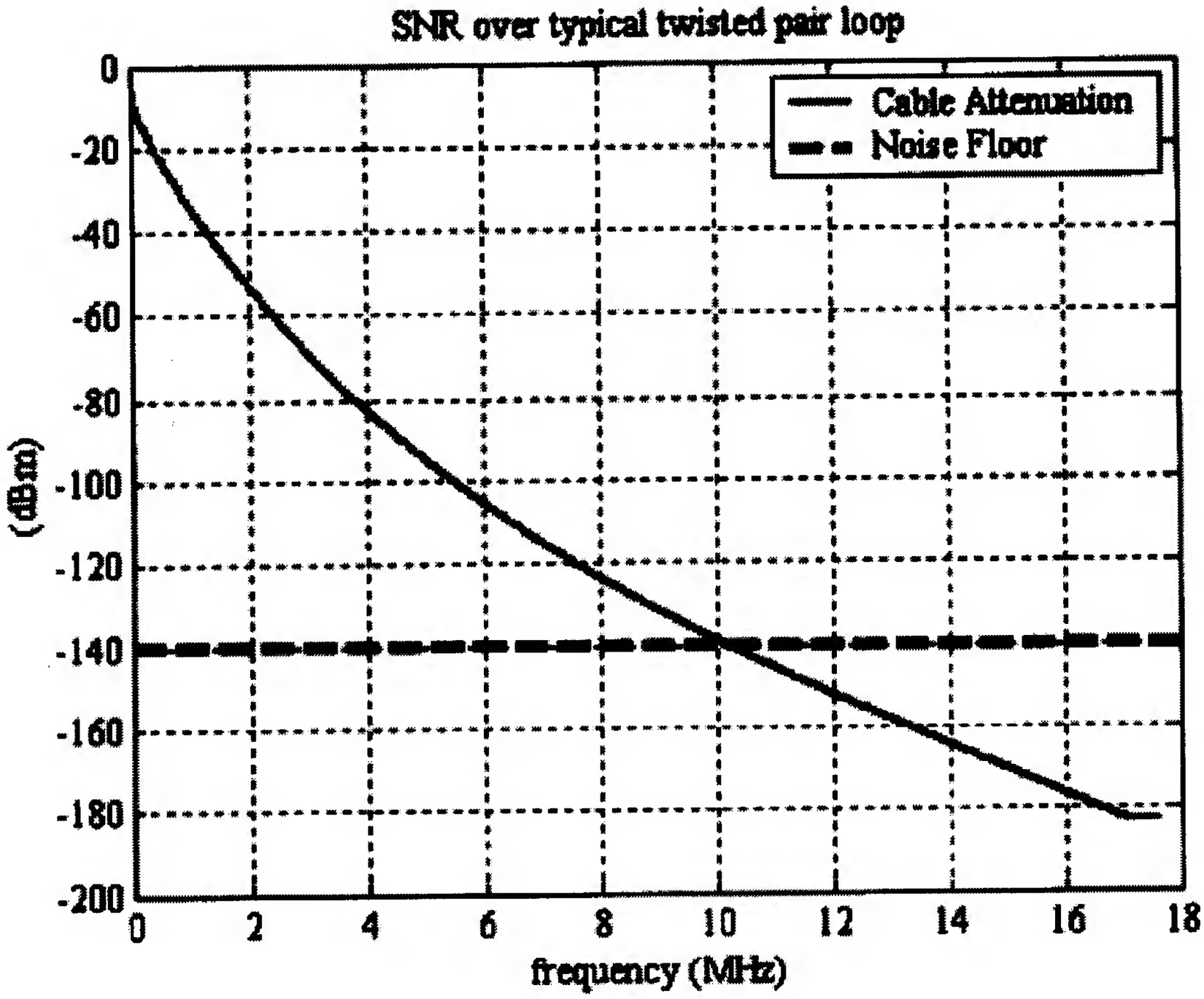
SNR over typical twisted pair loop
Cable Attenuation
Noise Floor
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
(dBm)
0
2
4
6
8
10
12
14
16
18
frequency (MHz)

Fig. 7

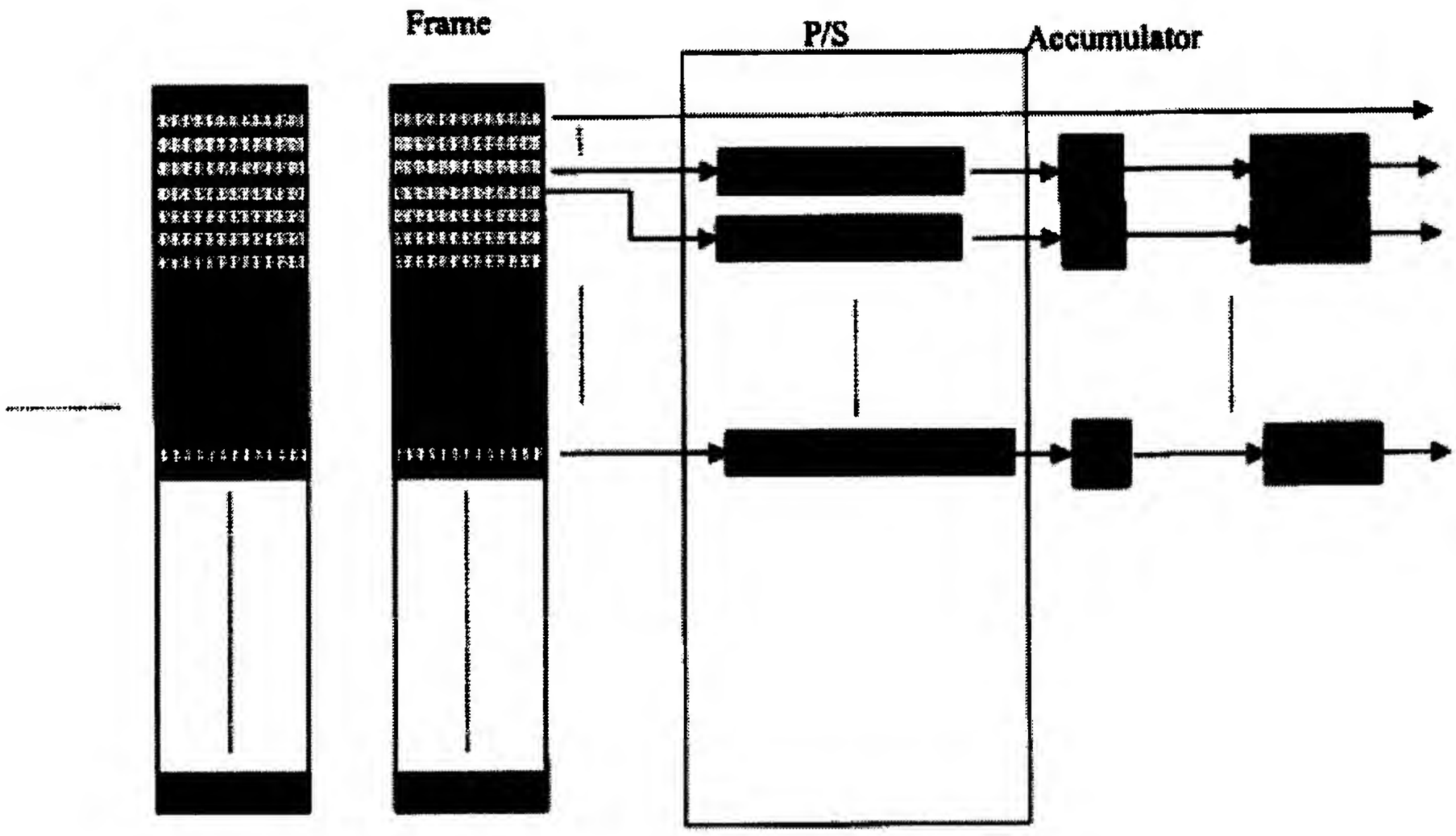

Fig. 8

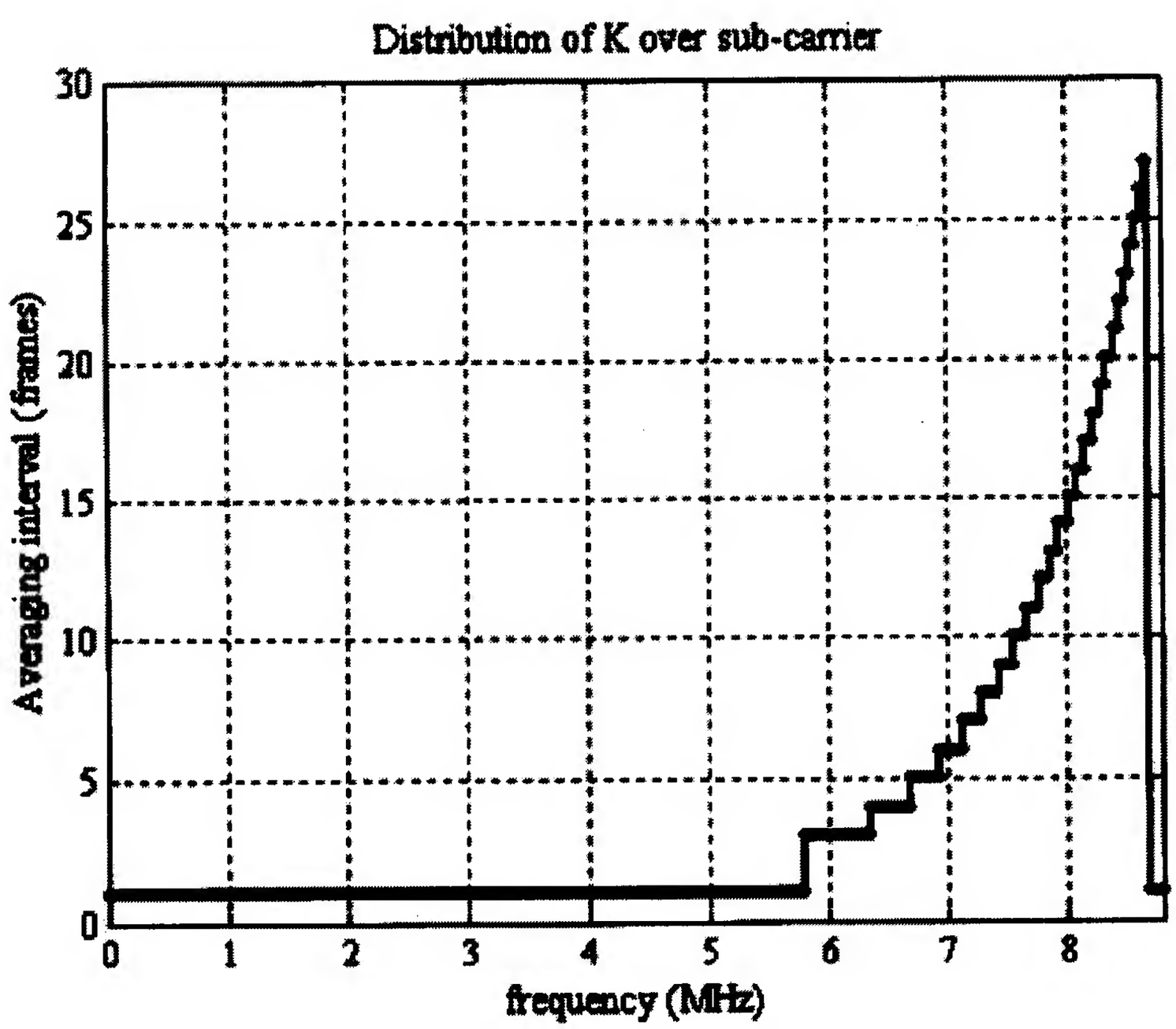
Distribution of K over sub-carrier
Averaging interval (frames)
frequency (MHz)
0
5
10
15
20
25
30
0
1
2
3
4
5
6
7
8

Fig. 9

(1) $$N_{useful} = \frac{(N/2-1)}{K}$$

(2) $$\sigma_{n'}^2 = \frac{1}{K}\sigma_n^2$$

(3) $$SNR = \frac{\sigma_s^2}{\sigma_n^2}$$

(4) $$SNR_{averaged} = K * SNR_o$$

Where SNR_o is the SNR of a particular carrier without using

(5) $$b_i = \left\lfloor \log_2\left(1 + \frac{SNR_{averaged}}{\Gamma}\right)\right\rfloor$$

Where i is the sub-carrier index, and Γ is the SNR gap. Moreover, operator $\lfloor\ \rfloor$ denotes the floor function.

(6) $$b_{frame} = \sum_{i=1}^{N_{useful}} b_i$$

(7) $$R = R_s * b_{frame}$$

Where R_s is the DMT frame rate.

Fig. 10

(8) $$b_i = \left\lfloor \log_2\left(1+\frac{SNR}{\Gamma}\right)\right\rfloor$$

(9) $$b_i = \frac{B}{R_s}\left\lfloor \log_2\left(1+\frac{SNR}{\Gamma}\right)\right\rfloor$$

(10) $$\sigma_{n'}^2 = \frac{1}{K}\sigma_n^2$$

(11) $$SNR_{averaged} = K * SNR_o$$

(12) $$b_{i,averaged} = \left\lfloor \frac{B}{R_s}\log_2\left(1+\frac{SNR_{averaged}}{\Gamma}\right)\right\rfloor = \left\lfloor \frac{B}{R_s}\log_2\left(1+K\frac{SNR_0}{\Gamma}\right)\right\rfloor$$

(13) $$\frac{2^{\lfloor b \rfloor \frac{B}{R_s}}}{2^{\lfloor b_{ave} \rfloor \frac{B}{R_s}}} = 2 = \frac{\left(1+K\frac{SNR_0}{\Gamma}\right)}{\left(1+\frac{SNR_0}{\Gamma}\right)}$$

$$= \frac{\Gamma + K * SNR_o}{\Gamma + SNR_o}$$

Fig. 11

(14) $$2\Gamma + 2SNR_o = \Gamma + K * SNR_o$$

(15) $$K = \left(1 + \frac{\Gamma}{SNR_0}\right)$$